AN 1651 – Analysis and design Of Analog Integrated Circuits

Two Mark Questions & Answers

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UNIT I

1.write the poissons equation.

= charge density

= electron charge

= permittivity of silicon

2.Write the equation of depletion region capacitance.

C_j =

3.If zero bias capacitance of a diffused junction is 3Pf and = 0.5V .Calculate the capacitance with 10V reverse bias.

C_j = 0.65 PF

4.Write some points about Zener break down.

Zener break down occurs in very heavily doped junctions where the electric field becomes large enough to strip electrons away from valance band. This process is called tunneling.

5.An abrupt pn junction has doping densities N = 5 10^5 atoms /cm^3 . and N_D = 10^{16} atoms/ cm^3 . Calculate the break down voltage if = 3 10^5 V/cm.

BV =88V.

6.What do you meant by large signal behavior.

Large signal models are developed for the calculation of total current and voltages in the transistor circuits, and such effects as break down voltage limitations , which are not usually included in the model.

7.Write the equation for ***Is*** **.**

8.Define the term ***Emitter injection efficiency.***

Emitter injection efficiency is equal to the ratio of electron current injected into the baser from the emitter to the total hole and electron current crossing the base emitter junction.

9.Define " ***Base Transport Factor***"

Base Transport Factor is defined as the fraction of charge carriers injected in to the base from emitter that reach the collector.

10. Draw the large signal model of ***PNP*** Transistor

11.Write the equation for ***"Base Width Modulation".***

12.What are the points to be considered for drawing small signal model.

Incremental or small signal models can be derived that allow calculation of current gain and terminal impedances without the necessity of including the bias quantities.

13.Define ***" Transconductance"***

Trans conductance is defined as the ratio of collector current to base emitter voltage.

14. Write the equations for r_{Π} ***and*** r_o.

15.Draw the small signal model of ***BJT.***

16. Write the drain current equation of ***JFET***.

17.Calculate the pinch off voltage for a P- channel JFET with parameters $N_A = 10^{15}$ cm^{-3} , $N_D = 10^{16}$ cm^{-3} .

18.Write the equation for large signal model of ***JFET.***

19.Define ***" Trans conductance in JFET".***

Trans conductance is defined as the ratio of Drain current to Gate source voltage.

20.Write all the capacitance present in ***JFET.***

Cgs =

Cgd =

Cgss =

<u>16 Mark questions.</u>

1.Explain the large signal behavior of MOSFET.

2. Explain the Small signal behavior of MOSFET.

3. Explain the large signal behavior of BJT.

4. Explain the small signal behavior of BJT.

5.Explain about the Depletion region in PN junction.

UNITII

1.Write some advantages of current source over resistors.

Current sources are frequently more economical than resistors in terms of die area required to provide the bias current of a certain value, particularly when the value of bias current required is small, when used as a load elements in transistor amplifiers, the high incremental resistance of the current source results in high voltage gain at low power supply voltages.

2. Define "Current source".

Current sources always produce the constant current to whatever element connected across the terminal.

3. For widlar current sources assume that Iref = 1mA and R2 = 5KΩ , neglect base current and find IC2.

4.Write the output resistance of widlar current source.

5.Write some advantages of Wilson current source over other current sources.

1. It is used to provide high output resistance ro.
2. Negative feed back is provided in Q_3 to raise the output resistance.

6.Write the current equation for Wilson current source.

7.Advantages of Widlar current source.

The Widlar current source is useful for obtaining small output currents.

8. Advantages of active load over passive load.

The use of PNP transistor as a load element allows high voltage gain without requiring large power supply voltages. Since the load element in such a circuit a PNP transistor instead of resistor, the collector load element is said to be active.

9. Write the equation for small signal voltage gain of the CE amplifier with active load.

10. Find the voltage gain of the CE amplifier with active load circuit when both devices are active. Assme pnp = 5 10^{-4} npn = 2 $10^{-4.}$

11. Calculate the output resistance of Differential amplifier with active load.

12.Write the equation for in the differential amplifier with active load.

13. Define “CMRR”

CMRR is common mode rejection ratio. CMRR is defined as the ratio of differential mode gain to common mode gain.

14.Define the term “Sensitivity”.

Sensitivity is defined as the percentile or fractional change in output current per percentile or fractional change of power supply voltage.

15.Why you use the startup circuitry.

An important aspect of self-biased circuits of this type is that they often have a stable state in which zero current flows in the circuit even when power supply voltage is non-zero. A separate startup circuit is usually required to prevent the circuit from remaining this state.

16. Define “ Fractional temperature co efficient” TCF.

Fractional temperature co efficient is defined as fractional change in output current per degree centigrade of temperature.

17.What is the use of VBE Multipler .

VBE Multiplier produces a voltage that is an orbitary fraction of VBE (on).

18.Advantages of Band gap referenced bias circuits.

The draw backs of the zener diode are that a power supply voltages of atleast 7 to 10v is required to place the diode in the break down region and that substantial noise is introduced in the circuit by the avalanching diode. But Band- gap referenced circuit provides zero temperature co efficient.

19. Give some output stages.

1. Emitter follower as an output stage
2. Common emitter output stage
3. Common base output stage
4. Class B(Push – Pull) output stage.

20. Write some points about output stages.

The output stage of an amplifier must satisfy a number of special requirements. One of the most importment of these is to deliver a specified amount of signal power to a load with acceptably low levels of signal distortion. Another common objective of output stage is to minimize the output impedance so that The voltage gain is relatively unaffected by the value of load impedance.A well designed output stage should achieve these performance specifications while consuming low quiescent power and that only by specified by a probability density function.

16- Mark Questions

1.Explain the DC analysis of CE amplifier with active load
2. Explain the DC analysis of differential amplifier with active load.
3. Explain the AC analysis of CE amplifier with active load.
4. Explain the AC analysis of differential amplifier with active load.
5. Explain the DC analysis of CS amplifier with active load
6. Explain the DC analysis of differential amplifier with active load.(MOSFET).
7. Explain the AC analysis of CS amplifier with active load.
8. Explain the AC analysis of differential amplifier with active load.(MOSFET).
9.Explain the V_t ,V_{BE}, V_Z Reference biasing.
10.Explain the Band-Gap referenced biasing in detail.
11.Explain the Emitter follower output stage.
12. Explain the Source follower output stage.
13.Explain push pull output stage.

UNITIII

1.Write the characteristics of ideal operational amplifier

1. input resistance =
2. output resistance = 0
3. Band Width =

2. Define input Bias current .

Input Bias current is defined as the average of two inpu current.

3.Define input offset current.

Input off set current is defined as the differential input current which must be applied to drive the output to zero.

4,Define input off set voltage.

Input off set voltage is defined as the differential input which must be applied to drive the output to zero.

5. Write some points about frequency response of operational amplier.

The voltage gain of the operational amplifier decreases at high frequencies.

6. Write some points about DC analysis of operational amplifier.

The first step is evaluating the performance of the circuit by determining the quiescent operating current and voltage of each transistor in the circuit.

7.Write some points about AC analysis of the operational amplifier.

The main objective of AC analysis is to determine the small signal properties of the operational amplifier. The small signal properties are 1) input resistance 2) output resistance 3) Transconductance of each stage.

8.Write the equation for finding out the 3 db frequency of the operational amplifier

9.Write the major classification of Noise.

1. Inherent Noise
2. Interference Noise
3. A.C Noise
4. D.C. Noise

10.Write some sources of Noise.

1. Shot Noise
2. Thermal Noise
3. Flicker Noise
4. Burst Noise
5. Avalanche Noisc

11. Define " Shot Noise"

Shot Noise is always associated with direct current flow and is present in diodes and bipolar transistors. Thermal agitation of electrons produce shot noise.

12. Calculate the shot Noise in a diode current of 1mA and the aaBand widyh of 1MHz.

13. What is the use of probability density function.

The Noise signal current produced by the shot Noise mechanism has amplitude that varies randomly with time and that only be specified by a probability density function.

14.Define thermal Noise.

Thermal Noise is generated by completely different mechanism from shot Noise. In conventional resistors it is due to random thermal motion of electrons and is un affected by presence or absence of direct current. Since this source of Noise is due to thermal motion of electrons.

15.Draw the Thermal Noise Models.

16. Define " Flicker Noise".

This type of Noise is found in all devices, as well as some discrete passive elements such as carbon resistors. The origin of Flicker Noise are varied, but in bipolar transistors it is caused mainly by traps associated with contamination and crystal defects in the emitter depletion layer. These traps capture and release charge carriers in the random fashion and the time constants associated with the process give rise to a noise signal with energy concentrated at lower frequencies.

17.Write the equation of Flicker Noise.

= small band width at frequency f
= direct current
= is a constant for a particular device.
= is the constant in the range 0.5 to 2
= constant.

18. Define "Burst Noise".

This is an another type of low frequency Noise found in some integrated circuits and discrete transistors. The source of the Noise is not fully understood; although it has been shown to be related to the presence of heavy metal ion contamination of gold doped devices show very high levels of burst noise.

19. Write the equation of "Burst Noise".

K_2 = is a constant for a particular device
C = constant in the range of 0.5 to 2
f_c = is a particular frequency for a given noise process.
I = direct current.

20. Define " Avalanche Noise"

This is the Noise produced by zener or avalanche break down in PN junction. In avalanche break down holes and electrons in the depletion region of a

reverse bias pn junction acquire sufficient energy to create hole electron pairs by colliding with silicon atoms.This process is cumulative resulting in the production of random series of Noise spikes.

16-Mark Questions

1.Explain the quantitative analysis of operational amplifier

2. Explain the D.C analysis of operational amplifier

3. Explain the A.C analysis of operational amplifier

4.Explain the frequency response of single stage amplifier

5. Explain the frequency response of multi stage amplifier.

6.Explain the frequency response of operational amplifier in detail.

7.Explain the Noise analysis in the operational amplifier.

8.What are the ways to improve the slew rate in an operational amplifier.

9.what is meant by slew rate and explain it in detail.

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UNIT IV

1.Define “noise figure“?

It is defined as the ratio of input S/N ratio to the output S/N ratio

Noise figure= $\frac{\text{input S/N ratio}}{\text{output S/N ratio}}$

F is usually expressed in decibels

2.What is meant by noise temperature?

It is a n alternative noise representataion and is closely related to noise figure. The noise temperature Tn of a circuit is defined as the temperature at which the source resistance Rs, must be held so that the noise output from the circuit due to Rs is equal to noise output due to the output itself.

3.Write the output current of two quadrant multiplier?

$\Delta Ic = \frac{KoVid[Vi2-Vbe(on)]}{2Vt}$

4.Write the output of the four quadrant multiplier?

$\Delta Ic = I_{EE}[\tanh(V1/2V_T)][\tanh(V2/2V_T)]$

5.Write some applications of multiplier ?

1.modulator

2.phase detector

6.Applications of phase locked loop?

1.It is used in satellite communication

2.Used in demodulators,stereodemodulators,tone detectors,frequency synthesizers

7.Write down the elements used in PLL

1.Phase comparator

2.Loop filter

3.Amplifier

4.VCO

8.What is the function of phase detector?

It produce a dc or low frequency signal proportional to the phase difference between incoming signal and VCO output signal.

9.Define “lock range”

The range of input signal frequencies over which the loop can maintain lock is called lock range

10..Define “capture range”

The capture range of the loop is that range of input frequencies around the center frequency on to which the loop will become locked from an unlocked condition.

11.What do you mean by pull in time?

The pull in time is the time required for the loop to capture the signal .

12.Write the function of Loop filter

The Loop filter is to filter out different components resulting from interference signal far away from the centre frequency. It also provides a memory for the loop in case lock is momentarily lost due to a large interfering transient.

13. Write the transfer function of PLL?

$$\frac{Vo}{\Phi i} = \frac{KdF(s)A}{1+\frac{KdF(s)AKo}{s}}$$

14.What are the parameters determine the performance of VCO

1.operating frequency range
2.FM distortion
3.centre frequency drift
4.centre frequency
5.supply voltage sensitivity.

15.What are the important elements used in complete analog multiplier?

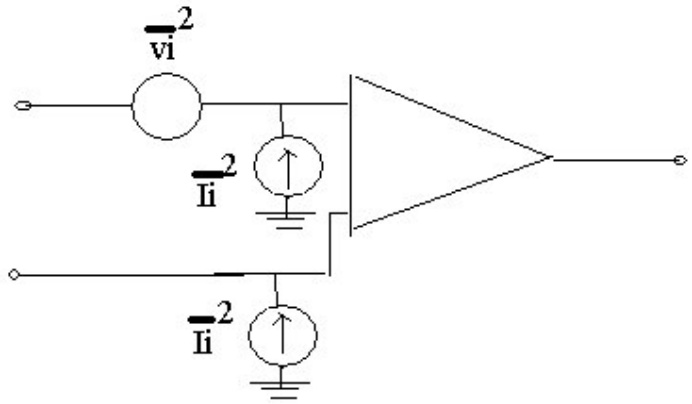
1.Two differential voltage to current converter
2.An output current to voltage converter

16. What do you mean by slew rate?

It is defined as the ratio of output voltage to time

Slew rate=dVo/dt=Ixm W2/gmI

17. Draw the complete op_amp noise representation



18.Write the equation of current noise present in FET?

$I_d^2 = 4KT(2/3gm)\Delta f * K I_D^2 \Delta f/f$

19.Define noise spectral density

It is defined as the ratio of mean square value of noise current source to frequency

$I_i^2 = S(f)\,\Delta f$

20.What are the various noise present in BJT?

1.shot noise
2.flicker noise
3.Burst noise

21. Write the equation of noise model injection diode

$Vs^{-2} = 4KTrs\Delta f$

$t^{-2} = 2qID\Delta f + K I_d^a \Delta f/f$

22.Write the equation of current noise present in BJT

$V_b^{-2} = 4KTrb\Delta f$

$t_c^{-2} = 2qIc\Delta f$

$t_b^{-2} = 2qIb\Delta f + KI I_B^a \Delta f/f + 2K I_B^c \Delta f/1+(f/fc)^2$

16 marks questions

1. Explain the complete analog multiplier

2.Explain the operation of VCO with neat diagram

3.Explain four quadrant transconductance multiplier

4.Explain the Dc analysis of gilbert multiplier with neat diagram

5. Derive the transfer function of PLL

6.Draw the complete diagram of monolithic PLL

UNIT V

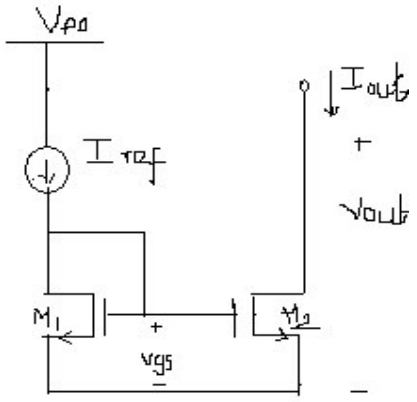
1.Write some advantages of **MOS** technology.

a) **MOS** transistors inherently display lower transconductance than ***BIPOLAR*** devices,leading to higher DC offset.
b) However , the virtually infinite input resistance of the device while used as an amploifier and zero offset when used as aswitch.

2.Write the output resistance of the **MOS** simple current source.

$$r_o = \left(\frac{I_D}{L_{eff}} \frac{dX_d}{dV_{DS}} \right)^{-1}$$

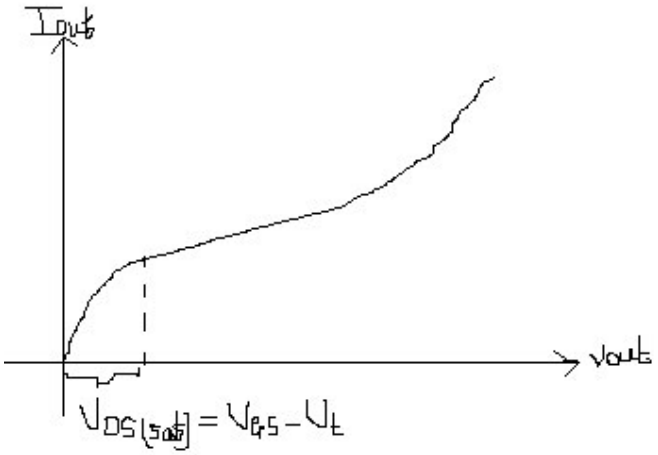
3.Draw the circuit diagram of ***simple current source***.



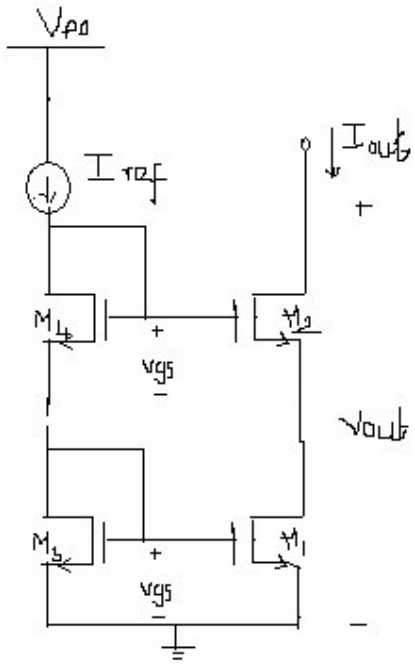
4.write the equation for V_{Thev} .

$$V_{Thev} = I_D r_o = \left(\frac{1}{L_{eff}} \frac{dX_d}{dV_{DS}} \right)^{-1}$$
$$= V_A = \frac{1}{\lambda}$$

5.Draw the I – V characteristics of the simple current source.



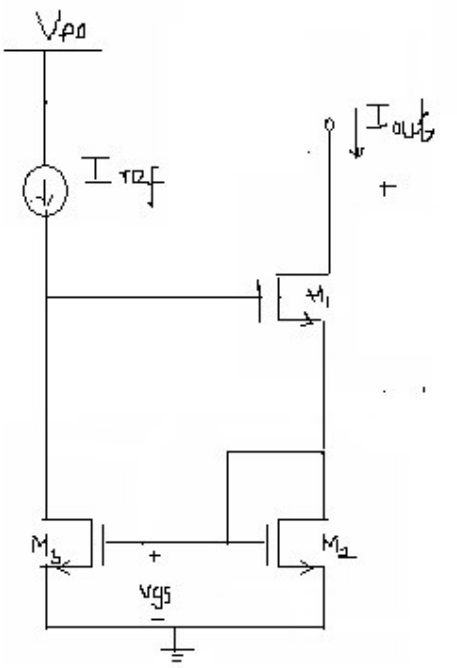
6.Draw the circuit diagram for ***cascode current*** source.



7.write down the small signal resistance of the cascade current source.

$$R_O = r_{o2}\,(\,1 + g_{m2}\,r_{o2}\,)$$

8.Draw the circuit diagram for ***Wilson current source*** .



9.Write the voltage gain of ***MOS*** single stage amplifier.

$$A_v = -\frac{g_{m_1}}{g_{m_2}} = -\sqrt{\frac{(W/L)_1}{(W/L)_2}}$$

10.Find the voltage gain of an ***NMOS enhancement – load inverter*** in which $W_1 =$ 100μ and the effective channel length L_1 is 6μ , and for the load $W_2 = 6\mu$ and the effective channel length L_2 is 30μ.

$$A_v = -\sqrt{\frac{(100/6)}{(6/30)}} = -28.9$$

11. What are the various biasing techniques available in the ***MOSFET***
    a) Supply independent biasing
    b) Temperature independent biasing

12.Write some of the temperature independent biasing techniques.

a) VBE reference biasing
b) VT reference biasing
c) VZ reference biasings

13.Write some applications of operational amplifier.

MOS operational amplifier Can be used as the switched capacitor integrator.

14.Why we go for temperature and supply independent biasing.

There should be wide fluctuation of bias current due to supply and temperature variations. These results in larger power dissipation so, that we go for temperature and supply independent biasing techniques.

16 – Mark Questions

1.Explain the ***MOS*** two stage operational amplifier in detail.

2.Explain the various referenced biasing techniques used in the ***MOS.***

3. Explain any two current sources in detail.

4.Explain the frequency response of ***CMOS*** operational amplifier.

5.Explain the ***D.C*** and ***A.C*** analysis of source coupled pair with active load.

6.Explain the small and large signal analysis of common source amplifier with active load